

# ***IDA***

INSTITUTE FOR DEFENSE ANALYSES

## **A Methodology for Independent Assessment of Advanced Warfighting Experiments**

John F. Kreis, Project Leader  
D. Robert Worley, Task Leader  
Dennis J. Gleeson, Jr.

19990310 005

January 1999

Approved for public release;  
distribution unlimited.

IDA Document D-2192

Log: H 98-002382

**DTIC QUALITY INSPECTED 1**

**This work was conducted under contract DASW01 94 C 0054, Task T-15-1524, for the Director, Joint C4ISR Battle Center, and the Joint Staff's Force Structure, Resources and Assessment Directorate. The publication of this IDA document does not indicate endorsement by the Department of Defense, nor should the contents be construed as reflecting the official position of that Agency.**

**© 1998, 1999 Institute for Defense Analyses, 1801 N. Beauregard Street, Alexandria, Virginia 22311-1772 • (703) 845-2000.**

**This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at DFARS 252.227-7013 (10/88).**

## **PREFACE**

This document was prepared by the Institute for Defense Analyses as an interdivisional effort by the Operational Evaluation Division and the Computer and Software Engineering Division for the Director of the Joint C4ISR Battle Center and for the Joint Chiefs of Staff's Force Structure, Resources and Assessment Directorate in partial fulfillment of the task "Assessments of the Joint C4ISR Battle Center." The object was to present a conceptual methodology that could be used to develop the scope and objectives and to assess the outcome of advanced joint warfighting experiments.

The IDA Technical Review Committee was chaired by Mr. Thomas P. Christie, and consisted of Dr. Gary Comfort, Mr. Dean DeWolfe, Dr. William Hurley, LTG Peter Kind, USA (Ret.), and Mr. Richard Miller.

# A METHODOLOGY FOR INDEPENDENT ASSESSMENT OF ADVANCED WARFIGHTING EXPERIMENTS

## Table of Contents

<b>SUMMARY .....</b>	<b>1</b>
A. Purpose of an Independent Assessment.....	1
B. Defining the Assessment's Scope and Objectives.....	2
C. Intended Outcome from the Assessment Plan.....	3
D. Framework.....	3
1. Assessment's Overall Design .....	5
2. Specific Assessment Areas .....	7
 <b>I. INTRODUCTION.....</b>	 <b>I-1</b>
 <b>II. DEFINING INNOVATION, EXPERIMENTATION, AND JOINTNESS.....</b>	 <b>II-1</b>
A. Innovation.....	II-1
B. Experimentation.....	II-4
C. Jointness.....	II-6
 <b>III. DESIGNING THE EVALUATION .....</b>	 <b>III-1</b>
A. Purpose of an Independent Assessment.....	III-1
B. Defining the Assessment's Scope and Purpose.....	III-2
 <b>IV. ASSESSMENT METHODOLOGY .....</b>	 <b>IV-1</b>
A. Intended Outcome from the Assessment Plan .....	IV-1
B. Framework.....	IV-1
1. Assessment's Overall Design .....	IV-3
2. Specific Assessment Areas .....	IV-5
C. Illustrative Operational Potential and Operational Supportability Issues .....	IV-6
1. Overall Issues.....	IV-6
a. <i>Operational Potential</i> Assessment Area Issues.....	IV-7

b. <i>Operational Supportability</i> Assessment Area Issues .....	IV-7
2. Subordinate Supporting Issues.....	IV-8
3. Examples of Assessment Issues.....	IV-8
a. For the Distributed, Collaborative Planning Concept or System .....	IV-8
b. For Firepower Delivery-Related Concept or System .....	IV-9
D. Measures of Potential and Measures of Supportability .....	IV-9
E. Sources of Data.....	IV-10
F. Experimentation Resources and Limitations.....	IV-11

Appendix A — Acronyms

Appendix B — Supporting Topics

### List of Figures

1. Developing an Experimentation Assessment Concept .....	3
2. Notional Advanced Warfighting Concept Assessment Issues.....	6
II-1. The Cyclic Model of Experimentation .....	II-3
III-1. Developing an Experimentation Assessment Concept .....	III-3
IV-1. Notional Advanced Warfighting Concept Assessment Issues.....	IV-4

## SUMMARY

This document suggests an approach for defining independent assessments of the results of joint advanced warfighting experiments undertaken in support of *Joint Vision 2010*. The joint experiments that we have in mind are those pursued in development of innovative operational doctrine or operational concepts to be employed by a joint task force, a unified command, or similar organization. It is during an assessment that one may see the possible effects on operational capability and military utility; independent assessments would have the goal of interpreting the operational potential of new warfighting concepts free of the biases of those who propose the capability or conduct the experiments.

Since their use throughout the military establishment is not standard, this document first presents some reasonable definitions of the meanings of *innovation*, *experimentation*, and *jointness* as used in the context of joint operations and the Chairman of the Joint Chiefs of Staff's vision for future warfighting capabilities. Then, the document describes the nature of experiments, their purposes, and how they support the development of advanced warfighting concepts that will be the focus of experimentation. Following that, we develop a structure for an independent assessment or evaluation of an advanced warfighting concept, and a methodology for independently assessing the success or failure of experiments dealing with future warfighting concepts are developed.

### A. PURPOSE OF AN INDEPENDENT ASSESSMENT

One of the characteristics of innovation and experimentation is the value in pushing an idea to the breaking point and learning its limits; failure is a virtue in this context. Those who must decide what to acquire or what new warfighting concept to try need to know under what conditions a proposed solution can be expected to succeed and under what conditions it may fail. Two or more complementary solutions might be required rather than a single solution. Assessing the value of warfighting experiments thus differs substantially from evaluations of new military systems.

Those who have been assigned responsibility for developing a specific material solution to Service needs do not see failure as an attractive option and usually try to avoid or reduce the risk of failure. Clearly, warfighting experimenters and system proponents would approach assessments quite differently. Those who are to evaluate the outcomes of warfighting experiments should bear in mind the desirability of understanding the conditions of failure as well as the potential conflicts between the interested parties.

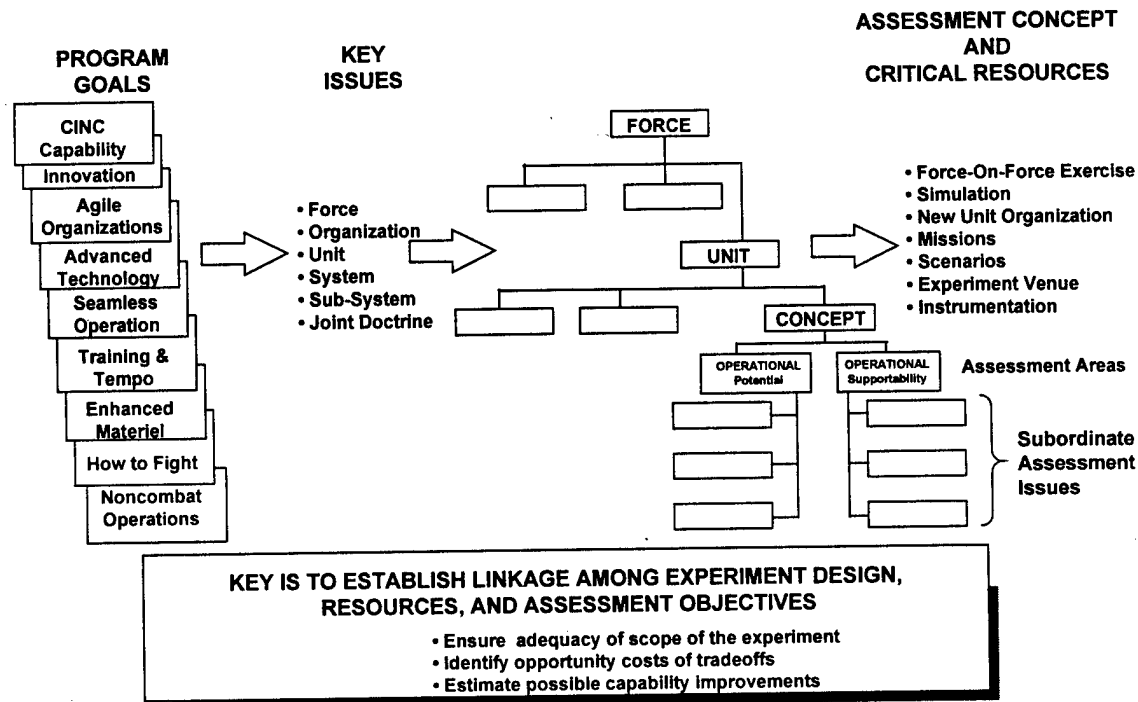
## **B. DEFINING THE ASSESSMENT'S SCOPE AND OBJECTIVES**

Systematic planning for advanced warfighting concept assessment can identify problems and organizational requirements and help the force planners and experimenters as well as the evaluators reach agreement on many points. Assessment plans are not meant to be directive in all respects. In their early form, they are conceptual structures meant to motivate and focus discussion between the proponents and evaluators on such topics as evaluation goals, experiment organization and design, and critical resources needed for the experiment to be conducted. Assessment plans also facilitate transition from conceptual thinking to defining the tasks needed to begin the actual experiment's organization. For this reason, evaluators need to be involved in the earliest stages of planning a joint warfighting experiment. Figure 1 illustrates the steps involved in designing an advanced warfighting experiment assessment plan, starting with the basic goals, then identifying key issues at the force, unit, and system levels, and finally identifying the main experimentation concepts and critical resources needed to implement the proposed experiment.

An assessment plan should clearly identify those issues central to determining whether the new warfighting concept has potential operational advantages and will have operational utility or suitability when employed by a force in the field. These are the *Critical Warfighting Innovations (CWIs)* of the new concept, and should be framed as questions phrased to pin down just what the new warfighting concept is supposed to provide.<sup>1</sup> There can be as few as one or two such questions, but they are vital because they establish the tone and purpose of the experiment (what the new capability should demonstrate), and make certain that everyone's expectations are similar. They are the foundation for the assessment of the experiment's outcome.

---

<sup>1</sup> Some innovations will be designed for operations other than war, and are not rightly "warfighting." Despite this, the purpose of a military force is to fight in the nation's defense. For this reason we have chosen to employ the term "*Critical Warfighting Innovations*" throughout the paper for consistency.



**Figure 1. Developing an Experimentation Assessment Concept**

Because innovation is a continuing and cyclic process, an assessment plan will be a living document that will change over time as more information about the experiment becomes available. The plan's early purpose is to evoke and to encourage debate about the final form of the assessment, to avoid as many last minute complications as possible, and to ensure that the assessment design is as complete as possible. When fully developed, the plan will guide the final evaluation of the experiment's outcome.

### **C. INTENDED OUTCOME FROM THE ASSESSMENT PLAN**

The warfighting experiment assessment plan serves to highlight certain variables for the decision makers: the issues of critical importance to a meaningful independent assessment; the alternative approaches for obtaining the needed data; and the complexity and associated costs (in broad terms) of the alternative approaches. The assessment plan should assist decision makers in reaching early agreement upon the principal issues to be addressed and the assessment approach to be employed.

### **D. FRAMEWORK**

In order to develop a cohesive assessment of any new warfighting concept, it may be necessary to make a number of assumptions as to the eventual working of the concept in its military application (either combat or operations other than war). These



assumptions may center on understanding the operational advantages and disadvantages of the application or on assessing the quality of data that will be available, not only to the evaluators, but also to those who will conduct the experiment, and the evaluators' ability to take actions based on those data. To do this, the proven approaches used for operational evaluation can help to frame the questions to be answered and then to guide the analysis of the experiment's outcome, or apparent outcome. For operational test and evaluation, these approaches are divided into areas dealing with operational effectiveness (in essence, answering the question: will the concept or system, under realistic operational conditions and used by typical military personnel, contribute to a unit's overall mission effectiveness?), and operational suitability (can the concept actually be employed and supported by the military system, and, if not, how must the system or concept be altered to accommodate the concept's implementation?).

To assess proposed advanced warfighting, however, a broader and less constrained approach than the operational effectiveness and operational suitability criteria used in planning operational test and evaluation for a major system acquisition is needed. The more free-ranging goals of joint warfighting experimentation or experiments requires that we adopt a flexible, but parallel, approach to understanding the value of new concepts. To examine advanced warfighting concepts, we believe that evaluators should frame their concerns in two assessment areas: *operational potential* and *operational supportability*. We shall use these latter terms to describe a generic evaluation framework.<sup>2</sup>

The *operational potential* issue area predominantly involves the warfighting unit's ability to use the advanced concept to organize, coordinate resources and capabilities, plan missions, integrate components' plans, achieve coordination with the various approval authorities, issue plans, carry out the plans, survive, and recover.

The *operational supportability* issue area relates to the ability of a concept when employed by a joint force commander to support that commander's needs in terms of the human requirements for its use and the user's ability to maintain an acceptable level of readiness, to interoperate with cooperating systems and commands, and to operate in a

---

<sup>2</sup> Another reason for using different assessment terminology is to avoid creating the impression that the concept, system, or system-of-systems in the experiment is involved in operational test and evaluation. OT&E is a much more formal process intended to satisfy a number of legal requirements and to support decisions about acquisition milestones. Should the object of the experiment eventually be part of OT&E, its operational effectiveness and operational suitability would be assessed in light of the then-current requirements.

congested environment or in an environment where an enemy is trying actively to disrupt operations. In addition, the experiment should yield certain data necessary for determining how manpower intensive and logistically demanding the concept will be when brought to operational use. Moreover, substantial warfighting changes will demand accompanying structural alterations having a bearing on force structure, support agencies, budgets, training, and the like. The nature and impact of these alterations must be understood as well.

### **1. Assessment's Overall Design**

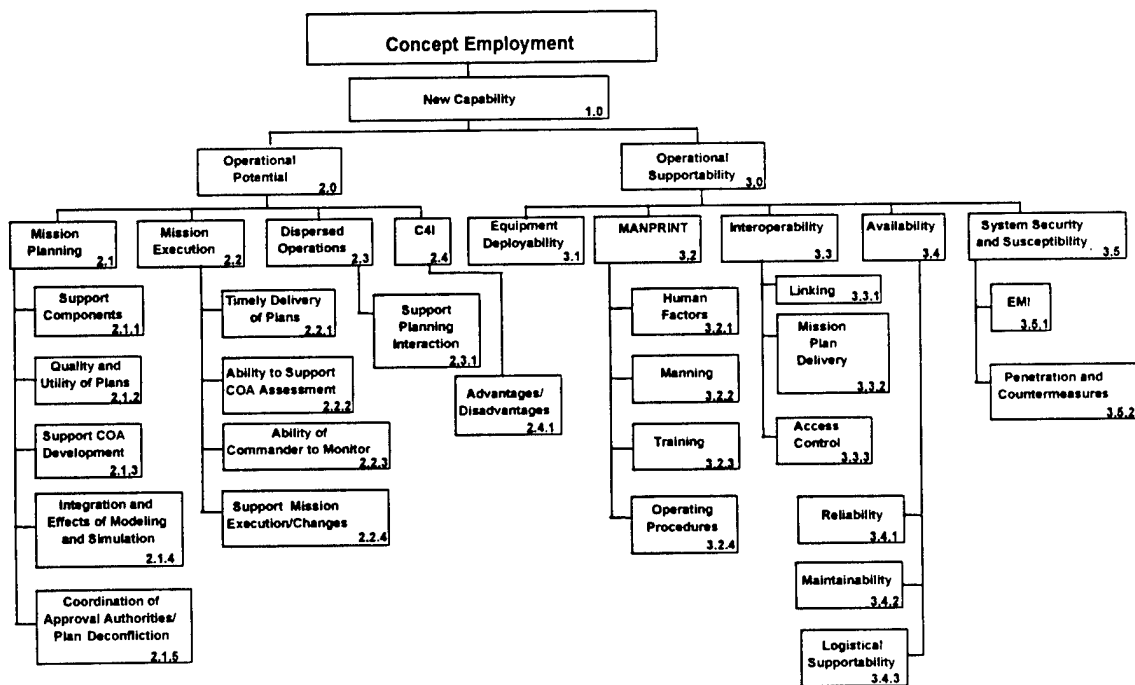
The experiment's design (and its assessment) should be built upon the *Critical Warfighting Innovations* described in Chapter III, and should be aimed at a logical progression of topics and decisions:

- Focusing on the warfighting concept's accomplishments as opposed to performance parameters.
- Describing unresolved mission deficiencies yet to be evaluated or to be the subject of follow-on experiments.
- Describing how the concept that is the subject of the experiment addresses potential mission deficiencies.
- Answering the question, "Did the experiment succeed in providing sufficient data from which to reach conclusions about the subject's performance?"
- Understanding what is adequate for experiment success.
- Understanding whether the subject of the experiment performed adequately (that is, one must understand how to measure success in a given case).

It is important to bear in mind here the difference between the experiment's failure to provide the information it was supposed to collect, and the warfighting concept's failure to meet expectations as the subject of the experiment.

An important major area to be addressed along with *operational potential* and *operational supportability* is an experiment's adequacy, and whether or not the experiment's venue or environment will provide the information needed not only for the independent assessment, but also for the final decision maker. The Assessment Plan is the appropriate mechanism to establish the hierarchical structure for the evaluation, as

depicted in Figures 1 and 2.<sup>3</sup> In Figure 2, the most all-encompassing issues to be weighed are associated with the topmost block (1.0), to determine whether the command can derive an advantage from employing the new warfighting concept. If the assessment cannot be made at this first level (and likely it cannot), then subsequent analyses must explore issues farther down (Blocks 2.0 and 3.0) to determine the causes and the significance of the advantages, shortfalls, or problems noted. It is especially important when a warfighting concept or system is pushed to failure while in an experiment or test that there be some type of assessment structure so that one may follow the issues of greatest importance until one is able to define the point at which failure occurred and the reasons why.



The numbers in the boxes correspond to the evaluation issues discussed in Chapter IV. Blocks 2.0 Operational Potential, and 3.0, Operational Supportability, are the assessment areas. The lower level blocks define the specific assessment issues.

**Figure 2. Notional Advanced Warfighting Concept Assessment Issues**

<sup>3</sup> Of course, a given experiment's assessment structure would depend upon the nature, extent and purpose of its subject's intended use. The warfighting innovation example on which the assessment description is built is a hypothetical operational concept and its supporting systems. The operational warfighting concept is a software intensive, distributed, collaborative planning system supported by worldwide communications. The topics to be explored in an actual experiment might not resemble those in this example.

## 2. Specific Assessment Areas

Using the statements of need or the requirements expressed by the potential users, such as a unified command or a JTF, the next task is to identify a set of *assessment issues (AI)*. The *AIs* will highlight a small number of issues, typically fewer than ten, whose satisfactory resolution will provide the information needed to determine the advanced warfighting concept's *operational potential* and *operational supportability*. From the answers to questions posed by the *AIs*, one may then develop an assessment of the value of the potential new capability.

*Assessment issues* are described in Chapter IV, as are the ways to measure operational potential and operational supportability; whenever possible, these measures should attempt to give quantitative information.

## I. INTRODUCTION

This document suggests an approach for defining independent assessments of the results of joint advanced warfighting experiments undertaken in support of *Joint Vision 2010*. The joint experiments that we have in mind are those pursued in development of innovative operational doctrine or operational concepts to be employed by a joint task force, a unified command, or similar organization. It is during an assessment that one may see the possible effects on operational capability and military utility; independent assessments would have the goal of interpreting the operational potential of new warfighting concepts free of the biases of those who propose the capability or conduct the experiments.

Since their use throughout the military establishment is not standard, this document first presents some reasonable definitions of the meanings of *innovation*, *experimentation*, and *jointness* as used in the context of joint operations and the Chairman of the Joint Chiefs of Staff's vision for future warfighting capabilities. Then, the document describes the nature of experiments, their purposes, how they support development of advanced warfighting concepts that will be the focus of experimentation. Following that, we develop a structure for an independent assessment or evaluation of an advanced warfighting concept, and a methodology for independently assessing the success or failure of experiments dealing with future warfighting concepts.

As used in this document, the term *concept* refers to the idea or proposal that is the subject of the warfighting experiment. A concept needs to contain several elements, including reasons why the concept is necessary (usually a short discussion of some mission deficiency that needs to be addressed); what is to be accomplished (in terms of goals or objectives, stated quantitatively, if possible); the operational environment in which the concept is expected to apply and, finally, a statement of *how* it is anticipated to be put into practice. Without this *how* element, it is little more than a mission statement or a task statement. In the same vein, a warfighting concept needs to include some way of judging or knowing when one has achieved one's warfighting goal, or won (or understanding when one is losing), if the concept were to be employed.

Thus, a concept is an abstraction that, when developed so that it can be put to military use, would become a capability. Stated another way, a concept, through a process of growth and development *may* become a military capability. Joint warfighting experiments are an integral part of the growth and development process leading to that capability.

If they are to be useful, warfighting experiments must be designed and evaluated with the idea in mind that they may fail to validate the warfighting concept that is the subject of the experiment. If failure is not an option, it is not an experiment.

## II. DEFINING INNOVATION, EXPERIMENTATION, AND JOINTNESS

Calls for military innovation and experimentation currently come from many quarters: Congress, Service schools, defense analysts, professional writing by military practitioners, and as justification for new projects and undertakings. The intent of those seeking to promote innovation varies, but is generally directed at questions of *how* or *whether* to change the style and structure of warfare to meet anticipated threats of the 21<sup>st</sup> Century or to reduce the cost of military forces and operations. Such innovation, however, implies different military forces or forces employed differently from those we have seen in the Department of Defense over the past several decades. Some possible changes are potentially far-reaching, involving newly developed joint operational doctrine and joint force employment done as has rarely been seen since World War II (and even then jointness as currently defined was unusual).

If such changes are to be implemented, the process carries with it a need for independent evaluation of the new operational capabilities to ensure that U.S. forces do not find out at the time of first combat employment that the new fighting concept or structure will not stand the stress of the encounter.

### A. INNOVATION

Despite all the rhetoric surrounding the need for newly designed forces and the innovation and experimentation needed to devise those forces, people who speak of *innovation* and *experimentation* in a military operations context do not always use or intend similar meanings for those words. Often, users have intuitive definitions in mind, but fail to state clearly what it is that they mean. Thus, a speaker may understand what he or she intends, but the audience is not so clear on the points being made. As a result, the ideas these two words convey and how innovation and experimentation should be designed and achieved are not necessarily the same to all those who discuss them. In the same vein, because a doctrine, system, or technology is new does not mean that it is inherently better than prior or existing systems, practices, or assets. This common association between *new* and *better* represents an example of the pitfalls of intuitive definitions.

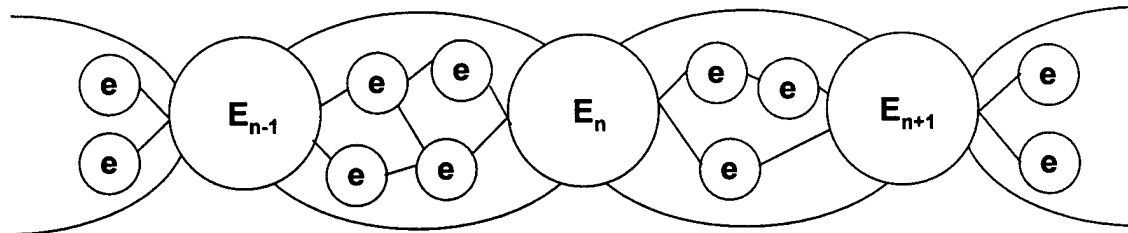
For example, several senior officers and members of Congress recently have used the term *innovate* in ways that imply achieving improvements or expansion of capability or reduction of costs of maintaining a military force: Senator Dan Coats calls for “leap-ahead capabilities,” General Dennis Reimer seeks “innovative means,” and Lt. Gen. Paul Van Riper wants the Services to find “new capabilities.” These men, however, do not always define their objectives in terms that are standard and quickly understood by others. The ambiguity of these phrases can contribute to miscommunications between the participants in the debate. Recent scholarship has added to our understanding of just what forces bring about change in military organizations. Change originates from the effects of military culture, from civilian efforts to alter the armed services driven by a variety of motivations, and from technological advances coupled with a general readiness and ability to apply new technology to warfighting, among others.<sup>1</sup>

Despite the different views on just what leads to innovation in the military, innovation is a continuing process. Ideas are tried out in special or periodic events as experiments based on some theory or expectation, often in a cyclic pattern, with each cycle leading to new understandings of operational capabilities or requirements. Usually, these cycles generate new questions needing new sets of experiments to answer them. These cycles, however, establish a series of baselines, with each baseline containing the results of the latest cycle of innovation and experimentation. Figure II-1 illustrates the cyclic model of innovation. In this model, innovation never ends and no goal will be met fully and completely; here, results of small experiments “e” feed more complex experiments “E,” leading to yet more questions to be answered. As improvements are made to a desired capability, the military and geo-political environment changes along with technological options.

---

<sup>1</sup> Air operations in World War II became possible because of remarkable growth in aircraft design and manufacturing (especially the use of machine tools for metal working). Amphibious warfare depended not only on development of the employment doctrine, but also on the parallel, but separate, design of boats and ships to make it feasible. See Barry R. Posen, *The Sources of Military Doctrine*, Ithaca, NY: Cornell University Press, 1984; Stephen P. Rosen, *Winning the Next War: Innovation and the Modern Military*, Ithaca, NY: Cornell University Press, 1991; and Allen R. Millett and Williamson Murray, *Military Innovation in the Interwar Period*, New York: Cambridge University Press, 1996.





**Figure II-1. The Cyclic Model of Experimentation**

For purposes of this paper, and to achieve uniformity of terminology in the discussion of design, execution, and assessment of advanced warfighting experiments, we shall use the following military-specific definitions:

- Innovate, v: to develop new doctrine, systems, or technologies that represent a departure from prior or contemporary military doctrine, systems, or technologies.
- Innovative, adj: representative of a departure from prior or contemporary practices
- Innovation, n: a new military doctrine, system, or technology that represents a departure from prior or contemporary military doctrine, systems, or technologies; or the process by which the military develops, explores, and possibly implements new military doctrine, systems, or technologies that represent a departure from prior or contemporary military doctrine, systems, or technologies.

It should be noted that these definitions do not address the magnitude of innovation, nor do they explicitly or implicitly signify an improvement over existing capabilities. New does not necessarily mean significant, radical, or better. We might want the new concept to be “better,” but better may be relative, depending on the scenario. How much of an improvement a new concept, technology, or doctrine provides should be demonstrated, in part, by an experiment.

The impact of a given innovation ought to be considered within an appropriate context. The fact that magnitude is relative should not be forgotten, and degrees of magnitude expected by innovation or to be demonstrated in experiments need to be clearly stated. Experimentation helps to discern the *better* from that which is simply *new*. A principal objective of the evaluation process is to judge the magnitude or degree of improvement or change that an advanced warfighting concept may offer – and in which circumstances the change might produce significant improvement. One should not lose sight of the fact that simply being new is all that a theater commander may need. Thus, the advantages of the newness should be one of the results of an experiment.

Military innovations can be assessed at three different levels: tactical, operational, and strategic. Each may produce a significantly different perception. Stephen P. Rosen, in *Winning the Next War: Innovation and the Modern Military*, offers the following summation concerning the nature and magnitude of innovation:

A major innovation involves a change in the concepts of operation of that combat arm, that is, the ideas governing the way it uses its forces to win a campaign, as opposed to a tactical innovation, which is a change in the way individual weapons are applied to the target and environment in battle. A major innovation also involves a change in the relation of that combat arm to other combat arms and a down-grading or abandoning of older concepts of operation and possibly a formerly dominant weapon.

## **B. EXPERIMENTATION**

As is the case with *innovation*, the terms *experiment* and *experimentation* are used equally loosely to explain varied approaches intended to achieve new force capability. Experiments are employed extensively in both the physical and the social sciences. At one extreme, physical scientists like physicists and chemists employ experiments in sterile laboratories using tight controls and measuring phenomena with great precision. The social scientist conducts experiments in a more natural setting. Still, the experiment designs of the physical and social scientist have a great deal in common. Military experiments are more aligned with the untidy world of the social scientist; knowing this will help us to understand how to prepare independent assessments of experimental and quasi-experimental designs that will assess the effectiveness and suitability of advanced warfighting concepts before they are transformed into joint or Service doctrine.

Although the process of assessing the outcome of experiments that explore advanced warfighting concepts bears a similarity to operational test and evaluation (OT&E), there are distinct and significant differences. OT&E is the field test, under realistic combat conditions, of any item of (or key component of) weapons, equipment, or munitions for the purpose of determining the effectiveness and suitability of the weapons, equipment, or munitions for use in combat by typical military users; and the evaluation of the results of such test. Such formal activity carries with it the requirement for test and evaluation plans, with reports (often to Congress). Assessments of proposed or potential warfighting concepts are much more fluid with the goal of observing the production of imaginative thinking. Should it come to pass that new acquisitions are planned as a result of the experimentation, then formal OT&E becomes a consideration.

Experiments do several things: 1) they can support heuristically guided investigations aimed at concept exploration; 2) they can support a goal-seeking trial and error procedure leading to implementation or performance improvements; 3) they can be used to test requirements or to characterize performance of a proposed advanced warfighting concept; and 4) when applied to characterize the performance of competing alternative warfighting concepts, can be used for purposes of comparative evaluation. The first type supports *discovery*, the second supports *invention*, and the third or fourth types support *evaluation*. Experiments are most useful in testing requirements or characterizing performance dealing with proposed advanced warfighting concepts. Military planning and development, however, can benefit from any type of experiment, depending on the purpose of the inquiry, the need, and the context of proposed employment of the new concept.

Overall, experiments are about acquiring knowledge of sufficient quality to inform decision makers, those who must create or approve innovative doctrine or initiate acquisition programs. The ultimate purpose is to improve military effectiveness. The experiment is the centerpiece of the experimental research method. But experimental research is only one of several styles of scientific inquiry, which, in turn, is only one form of knowledge acquisition. The scientists' definition of experiment relies heavily on controls: control of extraneous independent variables and observation of outcomes. The nature of warfare and of field trials, however, almost certainly limits or excludes heavy reliance on controls and the control of extraneous independent variables as would be done by a scientist. Moreover, one must be aware that the presence of a free-playing opponent and the wide range of environmental and political conditions attendant to war make suspect (but don't necessarily invalidate) the requirements or performance characteristics of any military experiment.

Lacking the ability to conduct military warfighting experiments with scientific rigor, independent assessments of new warfighting concepts are required.

The following definitions from the *American Heritage Dictionary of Science* are useful for understanding military warfighting experiments:

- Experiment, n: an operation conducted to discover, test, or illustrate some fact or phenomenon, especially one in which some hypothesis is tested by the manipulation of one variable in a controlled system.
- Experimentation, n: the act or process of experimenting.
- Note: the experimental method is often confused with the scientific method, but actually experimentation is only part of the latter.

Since these definitions are too highly structured to easily define the scope, extent, and flexible nature of inquiries into warfighting methods, we have modified them for use in understanding the scope of experiment assessments, as follows:

- Experiment, n: the act of attempting an innovative method of operation, especially to assess its feasibility, evaluate its utility or supportability, and determine its limits. This may include attempts using new systems, technologies, doctrine, or combinations of any of the three.
- Experimentation, n: the process of conducting experiments, especially when successive experiments are conducted to improve the performance or understanding of an innovative method of operation.

The above definitions were chosen to include the implicit demands for controlling independent variables, for predicting outcomes, and the need to conduct repetitive trials to achieve reliability — all of which are necessary to some degree for a successful experiment.

Scientific inquiry is set apart from other methods of knowledge acquisition by the ability to arbitrate between competing theories using a systematic and objective method. This ability stems from testing alternative explanations — comparing the outcomes of an experiment to operational needs and definitions. Given that we cannot control many of the variables in a warfighting experiment as would be done in a scientific experimentation setting (nor could we easily afford the cost of repetitive efforts seeking to demonstrate the same outcome), how then can one objectively arbitrate between alternative explanations? The answer lies in applying a combination of techniques from scientific experimentation and independent and objective testing. The ideas of formulating hypotheses, designing a test with an eye to internal and external validity (or at least an understanding of the test's shortcomings with respect to validity), and objective measurement and interpretation of results can and should be incorporated into appropriately designed experiments.

### **C. JOINTNESS**

Before achieving statutory legitimacy shortly after World War II, the Joint Chiefs of Staff functioned as a committee of co-equal Service chiefs with no one in charge. When a chairman was later authorized, he had no vote. A series of legislative reforms culminating in the Goldwater-Nichols Act of 1986 has given increasing authority to the Chairman of the Joint Chiefs and to the legally authorized joint commands. Still, many joint activities reflect the earlier meaning of joint: a committee of co-equal Service

representatives. Joint sometimes refers to the statutory joint offices including the Chairman and the Joint Staff, the unified commands, subordinate unified commands, and joint task forces. Implicit in this reference is the fact that these organizations' responsibility is at the strategic and operational levels of war as opposed to the tactical. Another meaning of joint is as indicated in programs of interest to more than one Service, e.g., the Joint Strike Fighter. Training exercises that are conducted to stress the interfaces between two Service headquarters are often incorrectly referred to as *joint* exercises rather than as *Service interoperability* exercises.

The Goldwater-Nichols Act of 1986 aimed at bringing matters into sharper focus. As a result of that Act, the Chairman of the Joint Chiefs of Staff received the responsibility, subject to the authority, direction, and control of the president and the secretary of defense, to develop doctrine for the joint employment of the armed forces, to formulate policies for the joint training of the armed forces, and to coordinate the military education and training of the armed forces.

Regardless of the statutory definition of authority to develop joint doctrine and oversee joint training, jointness means different things for different levels of the command structure. Unified commands and joint task forces deal with strategic or theater operational issues, and are increasingly trying to employ joint doctrine in their pursuit. The Service components engaged in combat or in operations other than war primarily are concerned with the tactical problems. The latter tend to employ Service doctrine in cooperation with each other.

Within the current context, certain formal definitions taken from official joint publications must be kept in mind.<sup>2</sup> The training community has provided some important definitions that are helpful to understanding the differences. Most important is the distinction between *component interoperability training*, a type of Service training, and *joint training*. Often, component interoperability exercises, typically conducted in the tactical time frame, are incorrectly called joint exercises. Apparently only a minor semantic infraction, it is, however, at the heart of significant miscommunications. Of similar importance is the common practice of conducting joint exercises concurrently with single-Service or component interoperability exercises, forcing the joint

---

<sup>2</sup> *Department of Defense Dictionary of Military and Associated Terms*, Joint Pub 1-02, 23 March 1994, and *Joint Training Policy for the Armed Forces of the United States*, CJCSI 3500.01, November 21, 1994.

headquarters to train in the tactical time frame, as opposed to the operational or strategic where it normally functions.

The major training categories, by DoD definition, are as follows:

- **Military Training:** The instruction of personnel to enhance their capacity to perform specific military functions and tasks; the exercise of one or more military units conducted to enhance readiness or ability to conduct military operations other than war. Training has three components: Service, joint, and multinational.
- **Service Training:** Military training based on Service policy and doctrine to prepare individuals and interoperable units. Service training includes basic, technical, operational, and component interoperability training. Component interoperability training can be the result of either combatant commander or Service initiative.
- **Component Interoperability Training:** Operational training in which more than one Service component participates. Normally, this type of training is based on CINC-based or Service-based initiatives to improve responsiveness of assigned forces to combatant commanders. The purpose is to ensure interoperability of combat, combat support, combat service support, and military equipment between two or more Service components.
- **Joint Training:** Military training based on joint doctrine to prepare joint forces and/or joint staffs to respond to operational requirements deemed necessary by the CINCs to execute their assigned missions. Deviations from these criteria may be made at the discretion of the respective combatant commander. For example, regional exercises focused on such CINC priorities as coalition building, overseas presence and access, demonstrating national resolve, and visible support for allies could be included in the Joint Training Plan.

Two additional definitions are useful to bear in mind concerning jointness and the preparation and evaluation of warfighting experiments:

- **Exercise:** A military maneuver or simulated operation involving planning, preparation, and execution. It is carried out for the purpose of training and evaluation.
- **Joint Exercise:** Exercises based on joint doctrine and procedures that train and evaluate joint forces or staffs to respond to requirements established by joint commanders to accomplish their assigned missions.

These definitional distinctions are important in that they not only provide a doctrinal template and common view, but also help to focus resources and means to achieve the integration of Service capabilities to reach, as stated in *Joint Vision 2010*, full

jointness institutionally, organizationally, intellectually, and technically. By having a clear understanding of what constitutes joint doctrine, joint training, and joint exercise, we are better able to consider how to innovate and apply experimentation appropriately within this new joint context.

### **III. DESIGNING THE EVALUATION**

A great many experiments are being considered for exploring new warfighting styles and methods and to anticipate the defense needs of the early part of the next century. Several are underway, and a number have already been conducted by the Services. In general, experiments fall into three categories, according to their purposes: *invention*, *discovery*, and *evaluation*. For example, where one sits relative to the acquisition process would dictate how one wished to apply the types of experiments. The most obvious dichotomy is the differing needs of those responsible for deciding what to acquire and those who must decide how to implement a solution. Yet another category of decision maker is the unified commander who might, at some point, need to employ not only a new system, but also an employment concept as yet untried in warfare.

Expecting a satisfactory assessment outcome from an experiment requires that those designing both the experiment and the assessment spend time at the beginning of the planning process clearly defining the issues, or questions, that need to be addressed by the experiment. These questions will drive the experiment's design and the data collection. There will be many participants in the experimental process: operators, experimenters, analysts, and decision makers; each will have differing perspectives. The design of the experiments and of the assessment concept should provide the simple, comprehensive, and transparent mechanism to ensure consistency and focus among these varied players.

#### **A. PURPOSE OF AN INDEPENDENT ASSESSMENT**

One of the characteristics of innovation and experimentation is the value in pushing an idea to the breaking point and learning its limits; failure is a virtue in this context. Those who must decide what to acquire or what new warfighting concept to try need to know under what conditions a proposed solution can be expected to succeed and under what conditions it may fail. Two or more complementary solutions might be required rather than a single solution.

On the other hand, those who have been assigned responsibility for developing a specific material solution do not see failure as an attractive option and usually conduct evaluations to avoid or reduce the risk of failure. Clearly, these two groups would



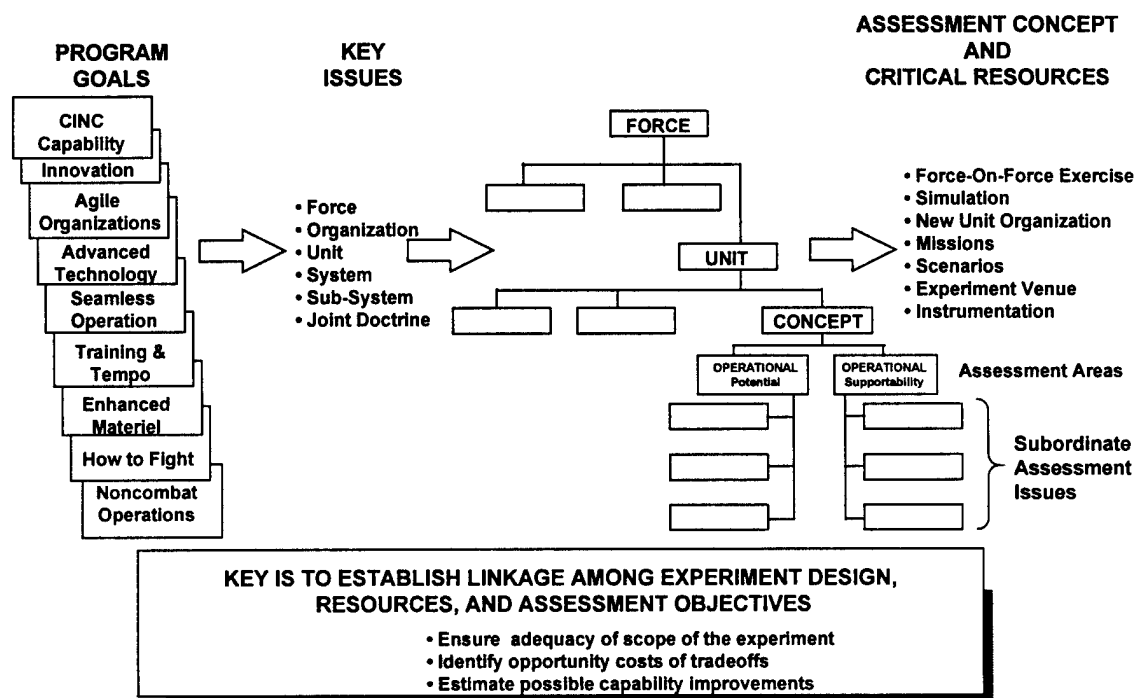
employ experiments quite differently. One group might use experiments to facilitate selection between alternative implementations, and thus appear as a potential threat to the advocate of any specific alternative. Those who are to evaluate the outcomes of warfighting experiments should bear in mind the desirability of understanding the conditions of failure as well as the potential conflicts between the interested parties.

In the acquisition world, initial operational test and evaluation determines the operational effectiveness and operational suitability of a production-representative system under realistic conditions (simulating combat conditions as nearly as possible), and establishes whether or not the users' minimum acceptable operational performance requirements as specified in the operational requirements documents (ORD) have been met. Those seeking advanced warfighting capabilities face a similar need: how to understand whether the warfighting concept, system, or system-of-systems with which they plan to experiment will provide them with answers to questions they have. Those questions about how to create new or different warfighting capabilities become the equivalent of the ORD, and can be narrow or wide-ranging, depending on the problem being addressed. Despite the topic of the experiment, the need for answers is no less pressing than in the case of system acquisition. Similarly, the answers, if they are to be employed in developing future warfighting changes, must be evaluated by skilled and independent reviewers. An Experimentation Assessment Plan can greatly assist in structuring a sound experiment and its evaluation.

## **B. DEFINING THE ASSESSMENT'S SCOPE AND PURPOSE**

Systematic planning for advanced warfighting concept assessment can identify problems and organizational requirements and help the force planners and experimenters as well as the evaluators reach agreement on many points. Assessment plans are not meant to be directive in all respects. In their early form, they are conceptual structures meant to motivate and focus discussion between the proponents and evaluators on such topics as evaluation goals, experiment organization and design, and critical resources needed for the experiment to be conducted. Preparing assessment plans also facilitates transition from conceptual thinking to defining the tasks needed to begin the actual experiment's organization. For this reason, evaluators need to be involved in the earliest stages of planning a joint warfighting experiment. Figure III-1 illustrates the steps involved in designing an advanced warfighting experiment assessment plan, starting with the basic goals, then identifying key issues at the force, unit, and system levels, and

finally identifying the main experimentation concepts and critical resources needed to implement the proposed experiment.



**Figure III-1. Developing an Experimentation Assessment Concept**

An assessment plan should clearly identify those issues central to determining whether the new warfighting concept has potential operational advantages and will have operational utility or suitability when employed by a force in the field. These are the *Critical Warfighting Innovations (CWIs)* of the new concept, and should be framed as questions phrased to pin down just what the new warfighting concept is supposed to provide.<sup>1</sup> There can be as few as one or two such questions, but they are vital because they establish the tone and purpose of the experiment (what the new capability should demonstrate), and make certain that everyone's expectations are similar. They are the foundation for the assessment of the experiment's outcome.

Defining the *Critical Warfighting Innovations* requires in-depth examination of the dependencies and interactions among the stated experimentation requirements; the experiment concept, guidelines and procedures; anticipated operating environments; and the technical characteristics of the subject of the experiment. An assessment plan's

<sup>1</sup> Some innovations will be designed for operations other than war, and are not rightly "warfighting." Despite this, the purpose of a military force is to fight in the nation's defense. For this reason we have chosen to employ the term "*Critical Warfighting Innovations*" throughout the paper for consistency.

developers must consider the best form of experimentation in order to collect the data needed to address the questions underlying the *CWIs*. The experiment's form may involve field testing, but it may, in addition or alternatively, involve modeling or human-in-the-loop, software-in-the-loop, and hardware-in-the-loop simulations. Assessment plans should consider the feasibility of proposed experiments in order to resolve in advance any potential problems that may result from anticipated limitations. The early identification of key resources needed to conduct the experiment in sufficient time to meet lead times should help minimize these limitations.

Because innovation is a continuing and cyclic process, an assessment plan will be a living document that will change over time as more information about the experiment becomes available. The plan's early purpose is to evoke and to encourage debate about the final form of the assessment, to avoid as many last minute complications as possible, and to ensure that the assessment design is as complete as possible. When fully developed, the plan will guide the final evaluation of the experiment's outcome.

## **IV. ASSESSMENT METHODOLOGY**

Many factors influence experiment designs, all under the umbrella of assessing the potential utility and suitability of a warfighting idea. An experiment's focus, however, must be on the ability of the candidate concept to provide new warfighting potential and to meet the evolving needs of possible users. The subject of experimentation and its relative success or failure, therefore, must be judged in terms of its ability to meet the goals set for it. To this end, it is important to select the most appropriate tools or sites for conducting the experiment, as well as the most appropriate size and organization of the group or team that is trying the concept. The assessment of a candidate entity needs to contain elements of uncertainty as would be faced in real life. The models and simulations that may be used to assist in the experiment must be carefully selected and must include considerations of verification and validation. Finally, the new warfighting concept must be judged in terms of its applicability within the military structure where it might be used, and changes to that structure that its adoption may require.

### **A. INTENDED OUTCOME FROM THE ASSESSMENT PLAN**

The warfighting experiment assessment plan serves to highlight certain variables for the decision makers: the issues of critical importance to a meaningful independent assessment; the alternative approaches for obtaining the needed data; and the complexity and associated costs (in broad terms) of the alternative approaches. The purpose behind the assessment plan is to assist decision makers in reaching early agreement upon the principal issues to be addressed and the assessment approach to be employed.

### **B. FRAMEWORK**

In order to develop a cohesive assessment of any new warfighting concept, it may be necessary to make a number of assumptions as to the eventual working of the concept in its military application (either combat or operations other than war). These assumptions may center on understanding the operational advantages and disadvantages of the application or on assessing the quality of data that will be available, not only to the evaluators, but also to those who will conduct the experiment, and the evaluators' ability

to take actions based on those data. To do this, the proven approaches used for operational evaluation can help to frame the questions to be answered and then to guide the analysis of the experiment's outcome, or apparent outcome. For operational test and evaluation, these approaches are divided into areas dealing with operational effectiveness (in essence, answering the question: will the concept or system, under realistic operational conditions and used by typical military personnel, contribute to a unit's overall mission effectiveness?), and operational suitability (can the concept actually be employed and supported by the military system, and, if not, how must the system or concept be altered to accommodate the concept's implementation?).

To assess proposed advanced warfighting, however, a broader and less constrained approach than the operational effectiveness and operational suitability criteria used in planning operational test and evaluation for a major system acquisition is needed. The more free-ranging goals of joint warfighting experimentation or experiments requires that we adopt a flexible, but parallel, approach to understanding the value of new concepts. To examine advanced warfighting concepts, we believe that evaluators should frame their concerns in two assessment areas: *operational potential* and *operational supportability*. We shall use these latter terms to describe a generic evaluation framework.<sup>1</sup>

The *operational potential* issue area predominantly involves the warfighting unit's ability to use the advanced concept to organize, coordinate resources and capabilities, plan missions, integrate components' plans, achieve coordination with the various approval authorities, issue plans, carry out the plans, survive, and recover.

The *operational supportability* issue area relates to the ability of a concept when employed by a joint force commander to support that commander's needs in terms of the human requirements for its use and the user's ability to maintain an acceptable level of readiness, to interoperate with cooperating systems and commands, and to operate in a congested environment or in an environment where an enemy is trying actively to disrupt operations. In addition, the experiment should yield certain data necessary for determining how manpower intensive and logistically demanding the concept will be

---

<sup>1</sup> Another reason for using different assessment terminology is to avoid creating the impression that the concept, system, or system-of-systems in the experiment is involved in operational test and evaluation. OT&E is a much more formal process intended to satisfy a number of legal requirements and to support decisions about acquisition milestones. Should the object of the experiment eventually be part of OT&E, its operational effectiveness and operational suitability would be assessed in light of the then-current requirements.

when brought to operational use. Moreover, substantial warfighting changes will demand accompanying structural alterations having a bearing on force structure, support agencies, budgets, training, and the like. The nature and impact of these alterations must be understood as well.

An assessment of advanced warfighting concepts should not be organized in such a way as to challenge the authority or correctness of those charged with seeking or developing the new capability. Rather, it is aimed at ensuring that the experiment's requirements are communicated in a manner that those conducting the experiment understand, and that allows a meaningful assessment of the outcome of the experiment.

### **1. Assessment's Overall Design**

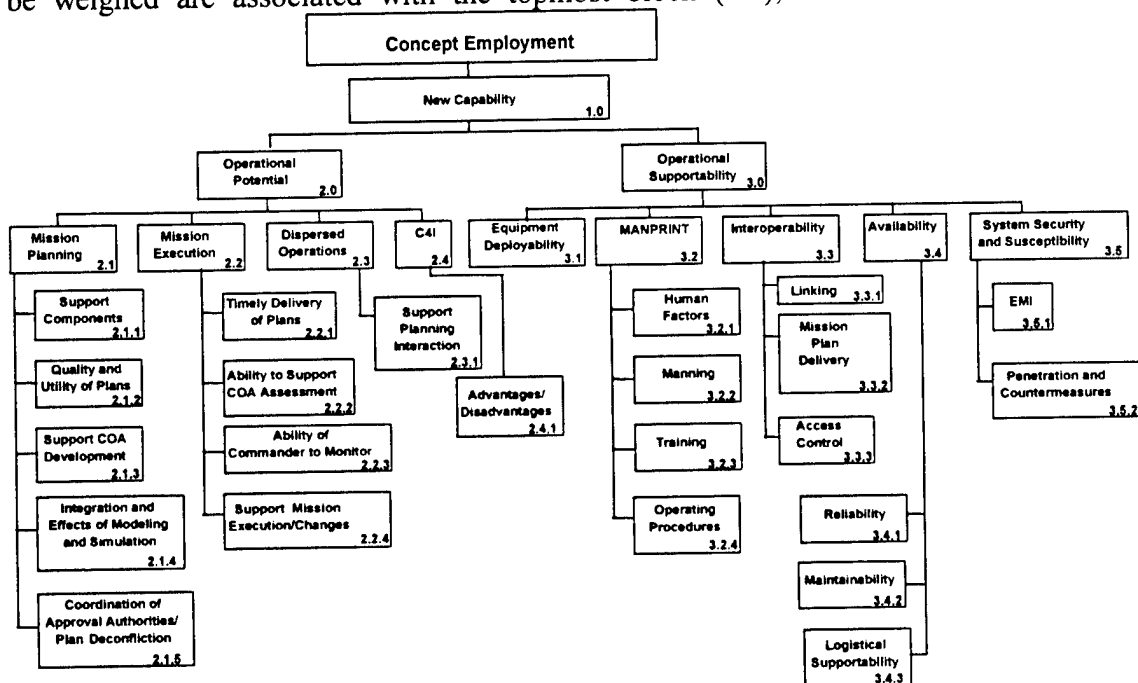
The starting point for this methodology is the statement of goals or capabilities or the operational changes to be demonstrated by the concept or entity that is the subject of the experiment. The intent is that the experiment should, in so far as possible, directly address those CINC or JTF needs, assess the degree of their satisfaction, or indicate other areas to be explored to determine the concept's feasibility. Although a number of constraints may limit achievement of this intent, proper design of the assessment issues will lead to understanding an experiment's objectives, its success at meeting them, and the ability of the subject of the experiment to provide a certain capability not previously available.

The experiment's design (and its assessment) should be built upon the *Critical Warfighting Innovations* described in Chapter III, and should be aimed at a logical progression of topics and decisions:

- Focusing on the warfighting concept's accomplishments as opposed to performance parameters.
- Describing unresolved mission deficiencies yet to be evaluated or to be the subject of follow-on experiments.
- Describing how the concept that is the subject of the experiment addresses potential mission deficiencies.
- Answering the question, "Did the experiment succeed in providing sufficient data from which to reach conclusions about the subject's performance?"
- Understanding what is adequate for experiment success.
- Understanding whether the subject of the experiment performed adequately (that is, one must understand how to measure success in a given case).

It is important to bear in mind the difference here between the experiment's failure to provide the information it was supposed to collect, and the warfighting concept's failure to meet expectations as the subject of the experiment.

An important major area to be addressed along with *operational potential* and *operational supportability* is an experiment's adequacy, and whether or not the experiment's venue or environment will provide the information needed not only for the independent assessment, but also for the final decision maker. The Assessment Plan is the appropriate mechanism to establish the hierarchical structure for the evaluation, as depicted in Figures III-1 and IV-1.<sup>2</sup> In Figure IV-1, the most all-encompassing issues to be weighed are associated with the topmost block (1.0), to determine whether the



The numbers in the boxes correspond to the evaluation issues discussed in Chapter IV. Blocks 2.0 Operational Potential, and 3.0, Operational Supportability, are the assessment areas. The lower level blocks define the specific assessment issues.

**Figure IV-1. Notional Advanced Warfighting Concept Assessment Issues**

<sup>2</sup> Of course, a given experiment's assessment structure would depend upon the nature, extent and purpose of its subject's intended use. The warfighting innovation example on which the assessment description is built is a hypothetical operational concept and its supporting systems. The operational warfighting concept is a software intensive, distributed, collaborative planning system supported by worldwide communications. The topics to be explored in an actual experiment might not resemble those in this example.

command can derive an advantage from employing the new warfighting concept. If the assessment cannot be made at this first level (and likely it cannot), then subsequent analyses must explore issues farther down (Blocks 2.0 and 3.0) to determine the causes and the significance of the advantages, shortfalls, or problems noted. It is especially important when a warfighting concept or system is pushed to failure while in an experiment or test that there be some type of assessment structure so that one may follow the issues of greatest importance *until one is able to define the point at which failure occurred and the reasons why*.

## **2. Specific Assessment Areas**

Using the statements of need or the requirements expressed by the potential users, such as a unified command or a JTF, the next task is to identify a set of *assessment issues (AIs)*. The *AIs* will highlight a small number of issues, typically fewer than ten, whose satisfactory resolution will provide the information needed to determine the advanced warfighting concept's *operational potential* and *operational supportability*. From the answers to questions posed by the *AIs*, one may then develop an assessment of the value of the potential new capability. Good judgment is necessary in preparing *AIs*, since assessing the importance of many of these issues is likely to be, at least partially, subjective. From experience, we know that there is no unique set, and, with the task of studying a proposed new warfighting capability, the need for sound preparation is even more crucial than for an operational test and evaluation where the requirements should be clearly stated in approved requirements document at the outset.

Moreover, to structure requirements or issues in any sort of meaningful hierarchy, one must estimate the relative impact of each upon mission accomplishment. Toward this end, the independent assessment team must review all possible analyses or studies of the problem conducted while the need for the new capability has been debated or discussed. It is unlikely (and unnecessary) for all members of the assessment team to agree initially on a single set of issues at this stage. The earliest distribution of a coherent set of *AIs* serves as the basis for establishing broad agreement with the potential users on the central focus of the assessment.

Several factors underlie the inclusion of any particular assessment issue. The issue must be demonstrably important to the experiment subject's operational capability. Second, it must highlight for assessment a design feature, technology application, operational procedure, or system interface unproven in the expected application or in the relevant mission scenario. Finally, the subject of the issue should be observable during



the experiment, for it does little good to state issues that cannot be seen by those who are to assess the outcome. The intent of an assessment plan for an advanced warfighting capability is to produce a structure of *AIs* and supporting issues that are clearly based upon mission and user requirements, exhibit inherent reasonableness, and encompass the known risks to *operational potential* and *operational supportability*.

### **C. ILLUSTRATIVE OPERATIONAL POTENTIAL AND OPERATIONAL SUPPORTABILITY ISSUES**

This discussion explores, in rather general terms, the issues that affect Block 2.0, *Operational Potential*, and Block 3.0, *Operational Supportability*, as illustrated in Figure IV-1, as well as the supporting issues farther down on the diagram. The questions posed here for each of the areas are representative, and not meant to exclude any other questions or legitimate lines of inquiry that may arise during experiment preparation, conduct, or, for that matter, the assessment preparation itself.

#### **1. Overall Issues**

These issues relate to blocks 2.0 and 3.0, and are the highest level questions that concern the advanced warfighting concept's capabilities.

For *operational potential*, will the concept support the joint force commander's mission requirements and operational goals? Can the warfighting concept do something new, or can it make current practices perform better, faster, or at lower cost? Does the concept under consideration resolve the deficiency originally identified? Normally, much of the information to answer these questions will be provided by analyses of the issues relating to Blocks 2.1, 2.2, 2.3, and 2.4.

For *operational supportability*, is the concept suitable for use by a force assigned a given task or mission, or can the joint force commander and any reach-back capability he may be able to use have the resource management capability to support the deployed force in its mission tasking? Can current systems and practices support the new concept? What changes may be needed? These questions usually will be answered by analyses of the issues relating to Blocks 3.1, 3.2, 3.3, 3.4, and 3.5.

Again, the specific issues shown here may not apply to any given experiment, and evaluators need to be prepared to define appropriate areas for each assessment.

**a. Operational Potential Assessment Area Issues**

1. *Mission Planning* (Block 2.1) includes those factors that allow the successful incorporation of the combatant commands as well as the JTF headquarters in compiling operational plans as well as the support of COA development and assessment; this topic includes the ability to gain access to data files needed in plan preparation. In addition, this area deals with the ability of planning systems to facilitate approval authorities' plan review actions and to improve the ability of Service and Agency liaison offices to expedite deconfliction of certain requirements and collection of other information needed by planners.
2. *Mission Execution* (Block 2.2) issues are those intended to measure changes in timeliness, in increased rehearsal opportunities, and in the ability of the commander and his staff to monitor and control mission execution, or in the ability to bring forces to bear at given locations.
3. *Dispersed Operations* (Block 2.3) issues cover the ways by which the new concept being evaluated helps or hinders participants at disparate locations, overt and covert, to participate in operations.
4. *C4I* (Block 2.4) issues deal with gaining an understanding of the ability of the new concept or system to take advantage of command, control, communication, computer and intelligence resources and technology to enhance operations. This includes determining how well the system can use established networks and how adaptable such networks are to the functioning of the new concept's employment.

**b. Operational Supportability Assessment Area Issues**

1. *Equipment Deployability* (Block 3.1) will evaluate the degree to which the concept requires and how well or how poorly the software and hardware components of new systems or organizations tolerate being moved by air, land, or sea to dispersed locations, then to be set up, and used. This includes movement to isolated locations and to areas that present a wide variety of environmental factors such as cold, heat and humidity, dust, and variable electric power.
2. *MANPRINT* (Block 3.2) addresses the assessment in terms of the human requirements needed for employment. In addition, this area covers the changes in manning within units that will be employed, the extent and difficulty of training necessary, and the adequacy of operating procedures that the users require.
3. *Interoperability* (Block 3.3) inquires into the consistency of the innovation to link any disparate planning or operating locations, the ability to simulate missions for analysis and to deliver complete plans or sections of plans to the locations that require them. Under this evaluation issue, the subject of

access control might evaluate the ability of the system to support a commander's or planning session leader's need to closely control who can participate and the susceptibility of the system to inadvertent changes in the work being done by participants. This area of assessment seeks to understand how well or how poorly the commander and his staff can deliver a disciplined product that can be the basis of an effective military operation.

4. *Availability* (Block 3.4) will evaluate the reliability and maintainability of the systems that compose the experiment to understand whether reliability and maintainability factors fall within the requirements desired by the users, and the effects of reliability on potential operations or C2. This area will also seek to understand how well the system can be supported by the military logistic structure or the supporting measures that will be needed.
5. *System Security and Susceptibility* (Block 3.5) is an important area that will establish for the users the trust that they need to have in systems before they can use them effectively. This area covers both the ability to function in the face of electromagnetic interference (EMI), both natural and man-made (including the ability to work in crowded electromagnetic environments of war or crisis times). The second topic will seek to determine the ability of the planning and supporting networks to resist attempts at penetration from any source as well as attempts at enemy countermeasures. This issue also will evaluate the ability of the system to provide secure, protected, non-locatable connectivity for dispersed planning sites.

## **2. Subordinate Supporting Issues**

Subordinate issues as illustrated in Figures III-1 and IV-1 are the lowest level and most specific questions to be answered. Supporting issues address those factors that appear to be most critical to understanding a concept's capabilities. Those in Figure IV-1 and discussed below are meant to be illustrative examples.

The following are examples of issues and supporting topics (See Appendix B for a more fully developed set of supporting topics for a potential generic distributed mission planning capability).

## **3. Examples of Assessment Issues**

### **a. For the Distributed, Collaborative Planning Concept or System:**

**(Issue) 2.1 Mission Planning** (See Figure IV-1)

How easily usable was the information, and could it be integrated into plans and operations as needed?

**(Supporting Topic) 2.1.1** *Does a system adequately support the commander as well as any geographically distributed components?*

Each node should have full and complete access to the system, with such access available during the preliminary inter-component discussions and subsequently during plan development and coordination stages.

For what portion of the time available for planning was the system able to support work by each participating planning staff?

Did the system provide access to databases with information on weather, intelligence, friendly forces, map and terrain features, and similar topics?

**b. For Firepower Delivery-related Concept or System (as a secondary example):**

**(Issue) 2.1 Target Planning**

**(Supporting Topic) 2.1.1** *Will the available UAV reconnaissance capability provide continuing imagery and target location accuracy to allow completion of fire plans and changes as needed by the commander?*

**(Issue) 2.2 Mission Execution (See Figure IV-1)**

**(Supporting Topic) 2.2.1** *Does the employment of the heavy brigade's firepower from offshore bring adequate accuracy and rate of delivery on targets?*

**(Supporting Topic) 2.2.2** *Can the JTF Commander monitor and control the application of firepower adequately?*

Is the commander able to operate geographically separate from the location of the artillery, but retain control and the ability to direct precise targeting and weapon delivery?

**D. MEASURES OF POTENTIAL AND MEASURES OF SUPPORTABILITY**

Having identified a proposed set of *AI*s and associated assessment issues, the next step is to address the character and diversity of information needed to resolve each issue. *Measures of Potential* and *Measures of Supportability* are defined for each assessment issue to provide a yardstick, or set of yardsticks, by which the issue's resolution may be judged. Where possible, quantitative measures are desirable. However, quantitative

measures are not always possible, particularly with explorations of advanced warfighting proposals, and qualitative measures will be needed as well. For example, a qualitative assessment such as an expert opinion might be used to judge the utility of the content and format of information displayed to a pilot, gunner, or to the JTF commander and his staff. By defining the set of required *Measures* (at least one for each assessment issue), the planning team is then able to focus upon the data requirements in order to support each identified *Measure*.

## **E. SOURCES OF DATA**

The methodology developed for the assessment should consider primary sources from which the data for measures of potential and measures of supportability might be obtained, such as wargames, field trials, manned simulators or computerized simulations and modeling, as well as the expert opinion of users. An early consideration of the available sources is particularly appropriate before experiment resources are fully allocated. In addition, some assets can only be made available with specified lead times because of programmed use for other projects.

In developing the utility and practicality of alternative experiment approaches, several factors are considered. These include:

- The scope of activity implied by each alternative. An experiment of limited scope might address only the concept's operational functionality, i.e., its ability to carry out its design functions when used in the field by typical operators. On the other extreme, a broadly defined experiment might measure the ability of the concept to accomplish its goals in a large-scale adversarial "battle," referred to as a force-on-force exercise.
- The need for specialized ranges or facilities. Ranges may provide controlled regions of air or ground space to support large-scale experiments. Further, ranges have in place varying types and amounts of instrumentation and data processing systems that would be useful in obtaining and recording data.
- The complexity of specialized instrumentation required. Instrumentation needs are a function of the types, quantity, and precision of data needed for the assessment.
- The number and skills of personnel required to conduct the experiment, monitor the collection of data, and prepare the assessment.

Although a field exercise is one method of obtaining *Operational Potential* and *Operational Supportability* data, the ability to address some assessment issues via such

direct field activity may be limited by safety, security, test range constraints, instrumentation limitations, or cost. In these cases, simulation or modeling may be the appropriate experimentation method.

During development of the assessment plan, alternative experimentation approaches are explored to determine the feasibility of resolving AIs in many ways. The resources needed to conduct the alternative approaches are outlined in broad terms, that is, things such as major instrumentation needs. In addition, consideration should be given at this point to the need and feasibility of conducting repeated trials to improve confidence in the results. The intent is to outline the framework of required experiment resources so that planning and budgeting can proceed.

## **F. EXPERIMENTATION RESOURCES AND LIMITATIONS**

Any trial of a new concept must include a realistic appraisal of the limitations of that trial, so that results may be judged in a straightforward manner with as little self-delusion as possible. Experimentation plans must provide for some such listing of shortcomings if for no other reason than to give users an idea of what they must do next in terms of development or assessment.

Limitations are those things that planners anticipate will *significantly* or *materially* affect their ability to address a major issue (either a *Critical Warfighting Issue* or an *assessment issue*). In stating the limiting factors, the linkage between potential limitations and the relevant *CWI* or *AI* needs to be clearly established, so that the decision makers conduct the experiment can assess the limitation's importance and effect on the outcome.

Very often new concepts being tried for the first time are not employed in an operationally realistic manner. The fact that there are great differences between structured demonstrations and an assessment where forces in the field are expected to employ a new system or concept of operation to meet operational goals does not always appear clearly in the planning. One way to achieve the goal of the experimental concept's assessment effort is to use a series of events. The series can begin with several limited exercises and progress to a much broader effort employing a selection of units that will, to a great extent, anticipate the activities of joint force organizations of the future.

## **APPENDIX A**

### **ACRONYMS**

AI	Assessment Issues
C2	Command and Control
C4I	Command, Control, Communications, Computers and Intelligence
CINC	Commander in Chief
COA	Course of Action
CWI	Critical Warfighting Innovations
DoD	Department of Defense
EMI	Electromagnetic Interference
JTF	Joint Task Force
ORD	Operational Requirements Document
OT&E	Operational Test and Evaluation
UAV	Unmanned Aerial Vehicle

## **APPENDIX B**

### **SUPPORTING TOPICS**

Note: The following topic examples are notional, with supporting criteria that are intended to provoke thought, not define the bounds of further planning efforts.

#### **A. OPERATIONAL POTENTIAL SUPPORTING TOPICS**

##### **2.1 Mission Planning**

*2.1.1 Does a system adequately support the commander as well as any geographically distributed components?*

Each node should have full and complete access to the system, with such access available during the preliminary inter-component discussions and subsequently during plan development and coordination stages.

For what portion of the time available for planning was the system able to support work by each participating planning staff?

Did the system provide access to databases with information on weather, intelligence, friendly forces, map and terrain features, and similar topics? How easily usable was the information, and could it be integrated into plans and operations as needed?

*2.1.2 Can the planning staffs, especially at any geographically separated sites, use the system to prepare a plan or plan segment that is of high enough quality for the JTF commander and his staff to use?*

*2.1.3 Will the system support development of the COAs suitable for the specific intended mission?*

Did the system provide adequate data (for example, intelligence, meteorological, order of battle) to support COA development?

Were planners able to develop more than one COA?

Were the planners able to assess each of the COAs?



Were sufficient and timely data available to support COA assessment?

*2.1.4 What was the ability of the system to integrate modeling and simulation with COA development, mission planning, and mission operations?*

Did the use of M&S speed or retard the flow of the experiment and how did it affect the concept under examination?

Could M&S provide a realistic threat and terrain picture, and thereby enhance the commander's options and decisions?

*2.1.5 Does the system adequately aid in coordination through each approval agency and authority?*

Can commanders and approval authorities expedite review in order to meet the planning and time redistribution needs?

Does use of the system expedite review of plans to allow Service component liaison offices to deconflict air space, fire support, and similar requirements? By how much has this been improved in relation to similar actions in previous mission operations?

At what point were plan drafts completed, and were review and coordination needed for the drafts other than what were accomplished during the distributed planning process?

## 2.2 Mission Execution

*2.2.1 Will the concept as subject of the experiment support operations in a timely manner?*

Measured against the baselines established during previous exercises or operations of a similar nature, did the system deliver approved, coordinated plans in time for mission execution?

How many iterations of the plan draft were prepared? What were the times they were completed?

When was the final plan ready for distribution?

How long did distribution of the completed plan take? Is this longer or shorter than the usual distribution time?

Did the system deliver plans without undue delay once delivery was directed?

*2.2.2 Does the distributed system give the commander an effective way of monitoring plan preparation and operations from a remote location?*

*2.2.3 Can the system support mission execution and changes to the plan as the need develops?*

### 2.3 Dispersed Operations

*2.3.1 Can the system support the interaction of distributed planners, of geographically separated subordinate units, and of the command and control authorities?*

### 2.4 C4I

*2.4.1 What C4I advantages or problems were evident during the experiment?*

What capacity communication links are necessary to fully implement the concept?

Taking into consideration the other data that must pass over these links, are the links adequate?

Do the links provide secure protection for planning and data transfer?  
(See section 3.5, System Security and Susceptibility.)

## **B. OPERATIONAL SUPPORTABILITY SUPPORTING TOPICS**

### 3.1 Deployability

*3.1.1 Can the necessary hardware and software that are part of the experimental system or concept be transported by land vehicles, rotary winged and fixed wing aircraft, or on boats and ships, and then be set up and function at the deployment location?*

To what extent did the equipment remain functional after transport, and could it be used effectively for mission execution at any dispersed sites?

### 3.2 MANPRINT for the system or concept components.

*3.2.1 Is equipment designed in such a way as to make it suitable for use by deploying forces in the field?*

What are the human factors problems associated with the system that adversely affect its suitability for use in the anticipated environments?

*3.2.2 What unit manning will be adequate to support requirements?*

How adequate are the skills of personnel assigned to the sites?

*3.2.3 How effective was the training?*

Was the training adequate to support the new concept's use in the experiment?

*3.2.4 Are operating procedures adequate?*

### 3.3 Interoperability

*3.3.1 Can the experiment function smoothly using available systems?*

Are "workarounds" needed to transfer data back and forth?

Do security standards and capability lend themselves to the employment concept, and to what extent must the participants take unusual or special actions to ensure protection of plans and planning factors?

What new support systems or capability will be needed?

*3.3.2 Can the experimental concept adequately meet mission simulation, COA assessment and refinement, and plan output delivery requirements?*

Of the total number of interoperability problems recorded, how many were attributable to the new concept, and how many to existing systems?

How many cannot be attributed to a specific source?

What adjustments might be needed in employing the new design?

### 3.4 Availability

*Is the operational availability of key components adequate to provide for extended periods of time?*

*3.4.1 What is the reliability of the new system or components critical to concept employment?*

Can it be measured in terms of mean time between operational mission failures (MTBOMF)? [Evaluators might have to determine the expected MTBOMF or other measures of reliability from sources to be provided.]

*3.4.2 Can key components be maintained by unit personnel? Is contractor maintenance and support to be needed, and to what extent will this affect employability?*

What was the mean time to repair (MTTR)/to reconfigure or reconstitute software?

What effect, if any, would there be if contractors had to be used to maintain key components?

*3.4.3 Is the concept or necessary supporting system logistically supportable?*

There may be no defined criteria for this issue, or few, if any, quantifiable requirements. Evaluators must approach the issue by attempting to understand the range of supply, transportation maintenance, and related problems faced by a system that could be used in disparate locations. How will logistics affect the concept's utility?

What are the special support functions needed, if any, and how do they affect system employment?

### 3.5 System Security and Susceptibility

*3.5.1 How will electronic interference and a crowded electronic spectrum affect planning and mission execution/monitoring?*

If no EMI evaluations are planned during the experiment, there may be gratuitous or inadvertent EMI affecting exercises and demonstrations of which evaluators need to be aware.

*3.5.2 To what extent might opposing force penetration be a problem?*

What are its potentials for security and protective countermeasures, how effective are they, and how does their employment affect operational effectiveness and suitability?

*3.5.3 Are adequate safeguards in place to prevent unauthorized entry into distributed C4 nets?*

Do the safeguards provide effective security?

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22203-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.			
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE January 1999	3. REPORT TYPE AND DATES COVERED August 1998 - December 1998	
4. TITLE AND SUBTITLE A Methodology for Independent Assessment of Advanced Warfighting Experiments		5. FUNDING NUMBERS DASW01-94-C-0054, OUSD(A) Task no. T-I5-1524	
6. AUTHOR(s) Dr. D. Robert Worley, Mr. John F. Kreis, Mr. Dennis J. Gleeson, Jr.			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Institute for Defense Analyses 1801 N. Beauregard Street Alexandria, VA 22311-1772		8. PERFORMING ORGANIZATION REPORT NUMBER  IDA Document D-2192	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Mr. Vincent J. Roske Wargaming, Simulation and Assessment Directorate, J8 Pentagon, Rm 1E965 Washington, DC 20318-8000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited. Directorate for Freedom of Information and Security Review (OASD-PA), 18 February 1999.		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This document suggests an approach for defining independent assessments of the results of joint advanced warfighting experiments undertaken in support of Joint Vision 2010. The joint experiments are those pursued in development of innovative operational doctrine or operational concepts to be employed by a joint task force, a unified command, or similar organization. Independent assessments would have the goal of interpreting the operational potential of new warfighting concepts free of the biases of those who propose the capability or conduct the experiments. Since their use throughout the military establishment is not standard, this document first presents some reasonable definitions of the meanings of innovation, experimentation, and jointness as used in the context of joint operations and the Chairman of the Joint Chiefs of Staff's vision for future warfighting capabilities. Then, the document describes the nature of experiments, their purposes, and how they support development of advanced warfighting concepts that will be the focus of experimentation. Following that, a structure for an independent assessment or evaluation of an advanced warfighting concept, and a methodology for independently assessing the success or failure of experiments dealing with future warfighting concepts are developed.			
14. SUBJECT TERMS Advanced Warfighting, Independent Assessment, Experimentation, Joint Vision 2010, Operational Evaluation		15. NUMBER OF PAGES 64	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited